

arch, with dark segments beneath; the arch was well defined and extended to an altitude of about  $15^{\circ}$ , and azimuth  $100^{\circ}$ , while the auroral light reached an altitude of  $140^{\circ}$ . After 10.05 p. m. no streamers appeared, although the arch remained visible until daybreak on the 19th, with but little variation in brilliancy and extent. A similar display occurred the following night.

Auroras were noted on other dates, as follows:

5th, Fort Sully, Dak. 6th, Cresco, Iowa; Lansing, Mackinaw City, and Marquette, Mich.; Fort Totten, Dak.; Saint Paul, Minn. 7th, Lyons, N. Y. 12th, Egg Harbor City, N. J. 14th, Fall River, Mass. 15th, Gardiner and Eastport, Me.; Poplar River, Mont. 17th, Berlin Mills and Nashua, N. H. 18th, Windsor, Ill.; Cresco, Iowa, Eastport, and Bar Harbor, Me.; Traverse City, Mackinaw City, Marquette, Escanaba, and Alpena, Mich.; Poplar River, Mont.; Moorestown, N. J.; Northfield, Vt. 19th, Windsor, Ill.; Vevay Ind; Eastport and Bar Harbor, Me.; Lansing, Traverse City, Swartz Creek, Mackinaw City, Escanaba, and Alpena, Mich.; Poplar River, Mont.; Egg Harbor City, N. J.; Charlotte and Northfield, Vt.; Green Bay, Wis. 20th, Pekin, Ill.; Bar Harbor, Me.; Mackinaw City, Mich.; Clayton, N. J.

#### THUNDER-STORMS.

Thunder-storms are reported to have occurred in the various states and territories on the several dates as follows:

1st.—Ariz., Ark., Cal., Colo., Dak., Fla., Ill., Ind., Ind. T., Iowa, Kans., La., Me., Mass., Mich., Mo., Mont., Nebr., N. Y., Pa., Tenn., Tex., Wis., Wyo.

2d.—Ark., Colo., Dak., Fla., Ill., Ind., Ind. T., Iowa, Kans., La., Me., Mass., Mich., Mont., Nebr., N. H., N. J., N. Y., Ohio, Pa., S. C., Tenn., Tex., Vt., W. Va., Wis.

3d.—Ala., Ariz., Colo., Fla., Ga., Ill., Ind., Ind. T., Iowa, Kans., Ky., La., Mich., Mo., Nebr., N. H., N. Mex., N. Y., Ohio, Pa., S. C., Tenn., Tex., Vt., W. Va., Wis., Wyo.

4th.—Ala., Ariz., Ark., Colo., Fla., Ga., Ill., Ind., Ind. T., Kans., Ky., La., Mich., Nev., N. Mex., N. Y., Ohio, Pa., S. C., Tenn., Tex., W. Va.

5th.—Ala., Ariz., Ark., Cal., Col., Fla., Ga., Ill., Ind., Ind. T., Kans., Ky., La., Md., Mass., Mich., Miss., Nebr., Nev., N. J., N. Y., Ohio, Oregon, Pa., S. C., Tenn., Tex., Va.

6th.—Ala., Ariz., Ark., Conn., Dak., Fla., Ga., Ill., Ind., Ind. T., Kans., Ky., La., Md., Mass., Miss., Mont., N. J., N. Y., N. C., Ohio, Oregon, Pa., R. I., S. C., Tenn., Tex., Vt., Va., Wash., W. Va., Wyo.

7th.—Ariz., Colo., Dak., Fla., Ga., Ill., Ind., Ky., La., Mass., Miss., Mo., Mont., Nebr., N. H., N. Y., N. C., Pa., R. I., S. C., Tenn., Tex., Va., Wyo.

8th.—Ala., Ariz., Cal., Colo., Dak., Fla., Ill., Ind., Iowa, Kans., Ky., La., Mich., Minn., Miss., Nebr., N. J., N. C., Ohio, S. C., Tenn., Tex., Va., Wis.

9th.—Ala., Ariz., Ark., Cal., Colo., Conn., Dak., D. C., Fla., Ga., Ill., Ind., Ind. T., Iowa, Kans., Ky., Md., Mass., Mich., Miss., Nebr., Nev., N. H., N. J., N. C., Ohio, Pa., R. I., Tenn., Tex., Utah, Vt., Va., W. Va., Wis., Wyo.

10th.—Ala., Ariz., Ark., Colo., Conn., Dak., Fla., Ga., Idaho, Kans., La., Me., Mass., Miss., Mont., Nebr., Nev., N. J., N. C., Pa., R. I., S. C., Tenn., Tex., Utah, Wyo.

11th.—Ala., Ariz., Ark., Colo., Dak., Fla., Ga., Ill., Iowa, Kans., La., Mass., Minn., Mont., Nebr., N. Mex., N. C., S. C., Tenn., Tex., Wis., Wyo.

12th.—Ala., Ariz., Ark., Colo., Dak., Fla., Ga., Ill., Ind. T., Iowa, Kans., La., Mich., Miss., Mo., Mont., Nebr., S. C., Tenn., Tex., Utah, Wis.

13th.—Ala., Ariz., Ark., Colo., Dak., Fla., Ga., Ind. T., Iowa, Kans., La., Mich., Miss., Mont., Nebr., Ohio, Pa., S. C., Tenn., Tex., Wis.

14th.—Ala., Ariz., Ark., Col., Dak., D. C., Fla., Ill., Ind. T., Kans., Ky., La., Mass., Minn., Miss., Nebr., N. J., N. C., Ohio, Tenn., Tex., Utah, Va., Wis., Wyo.

15th.—Ala., Ariz., Ark., Col., Dak., Fla., Ind. T., Kans., Minn., Mont., Nebr., N. Y., N. C., Ohio, Pa., Tenn., Tex., Utah, Va., Wyo.

16th.—Ala., Ark., Colo., Conn., Dak., Fla., Ga., Ill., Iowa, Kans., Md., Mass., Mich., Minn., Mont., Nebr., N. H., N. J., N. Y., Ohio, Pa., S. C., Tex., Utah, Va., Wis.

17th.—Ala., Ariz., Colo., Conn., Dak., D. C., Fla., Ill., Ind., Ind. T., Iowa, Kans., Ky., La., Md., Mass., Mich., Mont., Nev., N. J., N. Y., N. C., Ohio, Pa., R. I., S. C., Tenn., Tex., Va., Wis., Wyo.

18th.—Ala., Ark., Colo., Conn., Dak., D. C., Fla., Ga., Ill., Ind., Ind. T., Iowa, Kans., Ky., La., Md., Mass., Minn., Nev., N. J., N. Mex., N. Y., N. C., Ohio, Oregon, Pa., R. I., S. C., Tenn., Tex., Utah, Va., W. Va., Wis., Wyo.

19th.—Ala., Ark., Cal., Colo., Dak., D. C., Fla., Ga., Ill., Ind., Kans., Md., Mich., Minn., Miss., Nebr., N. J., N. C., Ohio, Pa., S. C., Tenn., Va., W. Va., Wyo.

20th.—Ala., Ark., Colo., Dak., Fla., Ga., Ill., Ind. T., Iowa, Kans., La., Miss., Mo., Mont., Nebr., N. C., Ohio, Pa., S. C., Tenn., Tex., Va., Wash., W. Va., Wyo.

21st.—Ala., Ark., Colo., Conn., Dak., D. C., Fla., Ga., Ill., Ind., Iowa, Kans., Ky., La., Md., Mich., Minn., Miss., Mo., Mont., Nebr., N. J., N. Y., N. C., Ohio, Pa., S. C., Tenn., Tex., Va., Wash., Wis., Wyo.

22d.—Ala., Ark., Colo., Conn., Fla., Ga., Ill., Ind., Ky., La., Md., Mich., Miss., N. J., N. Y., N. C., Ohio, Pa., S. C., Tenn., Texas, Vt., Va., Wash., Wyo.

23d.—Ala., Ariz., Ark., Conn., Dak., D. C., Fla., Ga., Idaho, La., Me., Md., Mass., Mont., Nebr., N. H., N. J., N. Y., N. C., Pa., S. C., Tenn., Texas, Va., Wash.

24th.—Ala., Ariz., Ark., Colo., Conn., Dak., D. C., Fla., Ga., Ind., Ky., La., Me., Md., Mass., Minn., Miss., Mont., N. J., N. Y., N. C., Ohio, Pa., S. C., Tenn., Texas, Va., Wash., W. Va.

25th.—Ala., Ariz., Ark., Colo., Dak., D. C., Fla., Ga., La., Me., Md., Minn., Mont., Nebr., N. J., N. Y., N. C., Ohio, Pa., S. C., Tenn., Texas, Va., Wash., W. Va.

26th.—Ala., Ark., Colo., Conn., Dak., D. C., Fla., Idaho, Ind., Kans., Ky., La., Md., Mass., Minn., Mont., Nebr., N. J., N. Y., N. C., Pa., S. C., Tenn., Va., W. Va., Wis.

27th.—Ark., Cal., Colo., Conn., Dak., D. C., Fla., Ga., Ill., Ind., Iowa, Kans., Md., Mass., Mich., Minn., Nebr., N. H., N. J., N. Y., N. C., Ohio, Oregon, Pa., Tenn., Texas, Va., Wis., Wyo.

28th.—Ariz., Ark., Cal., Dak., Fla., Ga., Idaho, Ill., Ind., Iowa, Me., Mass., Minn., Mont., Nebr., N. H., N. Y., N. C., Ohio, Oregon, S. C., Tenn., Texas, Vt., Va., Wis., Wyo.

29th.—Ala., Ariz., Ark., Colo., Conn., Dak., Fla., Ga., Iowa, La., Me., Mass., Mich., Minn., Nebr., N. H., N. J., N. Y., N. C., Pa., S. C., Tenn., Texas, Vt., Va., W. Va., Wis.

30th.—Ala., Ariz., Ark., Colo., Fla., Ga., Ill., Ind. T., Iowa, Kans., Me., Mich., N. H., N. J., N. Y., Ohio, Pa., S. C., Texas, Vt., Va., W. Va., Wis.

31st.—Ark., Colo., Conn., Dak., Fla., Ga., Ill., Ind., Kans., Ky., Me., Md., Mass., Minn., Mont., Nebr., N. J., N. Y., N. C., Ohio, Oregon, Pa., R. I., S. C., Tenn., Texas, Vt., Va., Wyo.

#### OPTICAL PHENOMENA.

##### HALOS.

1st-6th.—Lunar halos were quite numerous in the states to the south of the Ohio and east of the Mississippi Rivers during this period, while a few solar halos were observed in the districts to the northward. These halos were noted during

the passage of the area of low pressure, described as number i., from the middle Rocky Mountain slope to the Saint Lawrence Valley.

7-24th.—During this interval lunar halos were reported from but four stations, viz., Vevay, Ind., 7th; Erie, Pa., 8th;

Spartanburg, S. C., 11th; and Titusville, Fla., 24th. Neither were solar halos of frequent occurrence, only a few stations reporting them on scattering dates.

25th-31st.—In the states east of the Mississippi River lunar halos were reported from numerous stations, and solar halos were quite frequent in the Southern States. It was during this period that the tropical storm, described under areas of low pressure as number viii., passed from the region of the West Indies to the east Gulf states.

The phases of the moon, Washington mean time, during July, as given in "The American Ephemeris and Nauti-

cal Almanac" for 1887, are as follows: Full moon, 4th, 15 h. 25.9 m.; last quarter, 12th, 13 h. 48.8 m.; new moon, 20th, 3 h. 41.8 m.; first quarter, 26th, 21 h. 22.1 m.; apogee, 11th, 13.4 h.; perigee, 23d, 12.9 h.

#### MIRAGE.

Moorhead, Minn.: a mirage was observed at daybreak on the 22d; the outlines of the shores of two lakes lying about twenty miles east of this place were plainly seen.

Mirage was also reported to have been observed during the month, as follows: Vashon, Wash., 9th, 10th; Reidsville, N. C., 18th; Oswego, N. Y., 24th.

### MISCELLANEOUS PHENOMENA.

#### FOREST AND PRAIRIE FIRES.

Wellsborough, Tioga Co., Pa.: on the 11th and 12th about 4,000 acres of forest and partially cleared land in the vicinity of Gaines, in this county, were burned over. About five hundred cords of bark, several million feet of timber and lumber, a railway trestle, and several cars were destroyed.

Fort Spokane, Wash.: on the 13th and 14th fires were burning east and south of this station.

Helena, Mont.: fires were burning in the woods thirty-five miles north of this place on the 21st.

Forest and prairie fires are also reported to have occurred as follows:

Linkville, Oregon, 1st to 14th.

Fort Reno, Ind. T., 7th.

Fort Klamath, Oregon, 15th.

#### INSECTS.

Perham, Otter Tail Co., Minn.: a large amount of damage has been done by locusts to the crops in this county. In some places these insects have eaten everything except wild grass and the foliage of trees.

Saint Paul, Minn., 7th: reports from various localities in southern Minnesota state that crops of all kinds have been injured by chinch bugs. At about midnight on the 13-14th, swarms of insects known as "day bugs" or "swamp bugs," infested the city, obscuring the gas lamps and covering the streets and pavements in many places from six inches to one foot deep. These insects disappeared after sunrise on the 14th.

Omaha, Nebr., 11th: reports from several sections of this state show that chinch bugs are causing serious injury to wheat, oats, and corn.

Quakertown, Bucks Co., Pa., 16th: during the earlier part of the month some injury was done by potato bugs and caterpillars in this county.

Morse, Johnson Co., Kans., 17th: chinch bugs are beginning to do injury in this locality; potato bugs have also appeared to some extent.

Mason City, Cerro Gordo Co., Iowa.: during a part of the afternoon of the 19th large swarms of chinch bugs filled the air so as to render walking in the streets very disagreeable.

Saint Peter, Nicollet Co., Minn.: large numbers of chinch bugs appeared in this vicinity on the 19th.

Campton, Kane Co., Ill., 22d: grasshoppers have injured the corn crop in this county.

Manhattan, Riley Co., Kans., 30th: chinch bugs have done considerable damage in this locality.

Humphrey, Cattaraugus Co., N. Y., 30th: grasshoppers are very numerous in this county.

Forsyth, Monroe Co., Ga., 31st: cotton worms are doing injury to cotton.

Embarras, Waupaca Co., Wis., 31st: chinch bugs are very numerous in this locality.

#### METEORS.

Earleton, Alachua Co., Fla.: two meteors were observed on the evening of the 11th; the first was seen falling due south at 8.30 p. m., and appeared as a large red ball, which separated into two parts, both disappearing before reaching the hori-

zon. The second meteor fell in a curve from north to southeast at 8.50 p. m.; beginning small, it grew rapidly larger and disappeared behind a cloud, but, by the bright light around the edges of the cloud, the observer could time the point of explosion.

Graud Junction, Greene Co., Iowa: a large meteor was observed at 8.30 p. m. on the 25th; it started in the northern sky and traveled due west for about 30°, leaving a bright trail in its path.

Topeka, Kans.: a large meteor was reported to have been observed at about 9 p. m. on the 25th; it was first seen in altitude 35° and azimuth 330°, having a slow and wavy motion, which the observer states resembled that of a ball when tied up in a handkerchief and thrown.

Des Moines, Iowa: an unusually bright meteor was observed at 9.30 p. m. on the 25th; it started at a point about 40° east of south, shot across the heavens at an altitude of about 30°, and disappeared when about 35° west of south.

Delaware, Walworth Co., Wis.: a large meteor was observed in the western sky at 8 p. m. on the 25th; it fell in a north-westerly direction, leaving a train of sparks.

Dubuque, Iowa: a meteor passed over this city from southeast to northeast at 12.05 a. m. on the 27th, leaving a bright trail which remained visible several seconds.

Cairo, Ill.: a brilliant display of meteors was observed in the western sky in altitude about 50°, between 12.30 and 1.00 a. m. on the 27th.

East Portland, Oregon: a very brilliant meteor was seen at midnight on the 29th; it moved in an easterly direction and exploded in the northeastern sky.

Meteors were also observed during the month on the following dates:

1st, Elkin, Ky.; Beverly, N. J. 2d, Vevay, Ind. 3d and 4th, Elkin, Ky. 5th, Manatee, Fla. 6th, Elkin, Ky. 7th, Clayton, N. J. 8th, Kalamazoo, Mich.; Quakertown, Pa. 9th, Beverly, N. J. 10th, Concord and Nashua, N. H. 11th, Duke and Archer, Fla.; Nashua, N. H. 12th, Independence, Iowa; Nashua and Concord, N. H. 13th, Stateburg, S. C.; Nashua and Concord, N. H. 14th, Keeler, Cal.; Dudley, Mass. 15th, Charleston and Pekin, Ill. 16th, Archer, Fla. 17th, Manatee, Fla.; Charleston, Ill. 19th, Charleston, Ill. 21st, Manatee, Fla. 25th, Davenport, Iowa; New Midway, Md.; Beverly, N. J. 26th, Delavan, Wis. 27th, Davenport, Iowa. 28th, Butlerville, Ind.; Independence, Iowa. 29th, Davenport, Iowa; Kalamazoo, Mich.; 30th, Davenport, Iowa; Kalamazoo, Mich.

#### MIGRATION OF BIRDS.

The Voluntary observer at Elkin, Clark Co., Ky., reports ducks flying northward on the 6th.

#### SUN SPOTS.

Mr. H. D. Govey, of North Lewisburg, Champaign Co., Ohio, reports having observed sun spots on the following dates: 1st to 3d, 5th to 7th, 10th to 16th, 23d to 30th; four large spots were observed on the 10th, extending in a straight line nearly across the centre of the sun.